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(56) Documents cited
GB A 2062236 **GB 1146656**
GB 1347682 **GB 0837615**

(58) Field of search
G1N

(54) **Measuring electrically parameters of a cable being laid**

(57) The tension force in the cable laid from a winch, the length of the laid cable and measured values of cable ducts are converted into electrical values for evaluation and display by a microprocessor system. In Fig. 1, the cable tension is derived from strain gauges 3 on a shaft 1 bearing a pulley 2 over which the cable passes. A magnetic or optical sensor 4,5 measures the length of the cable and by combination with a time signal, the speed can also be obtained. The tension can alternatively be derived by measuring the lateral deflection of a pulley using an inductive sensor or by incorporating an inductive sensor in a cable termination device which can also measure parameters of a duct in which the cable is being laid.

Fig. 1

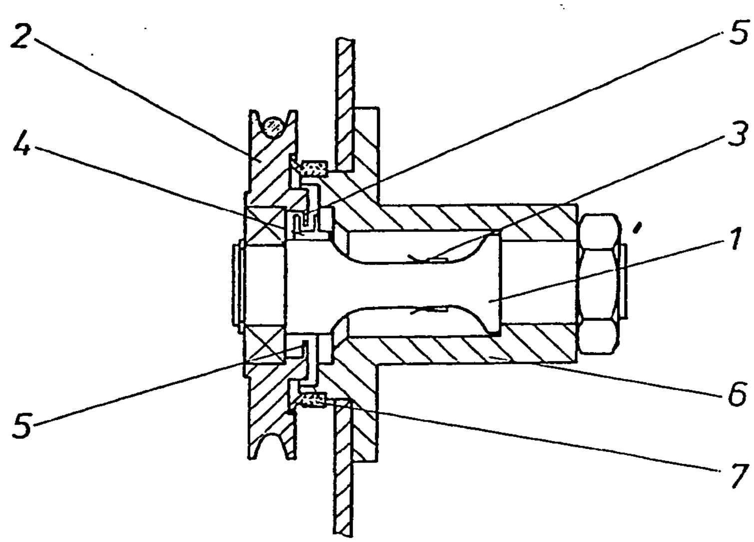

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Fig. 1

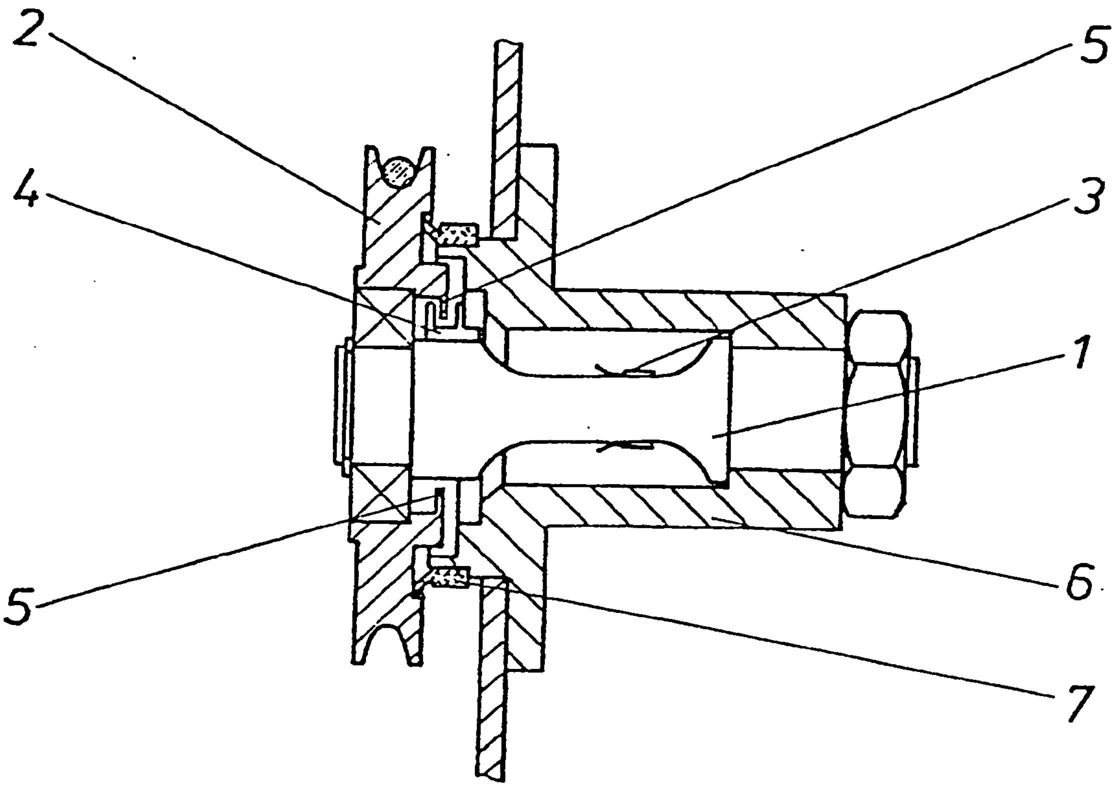


Fig. 2

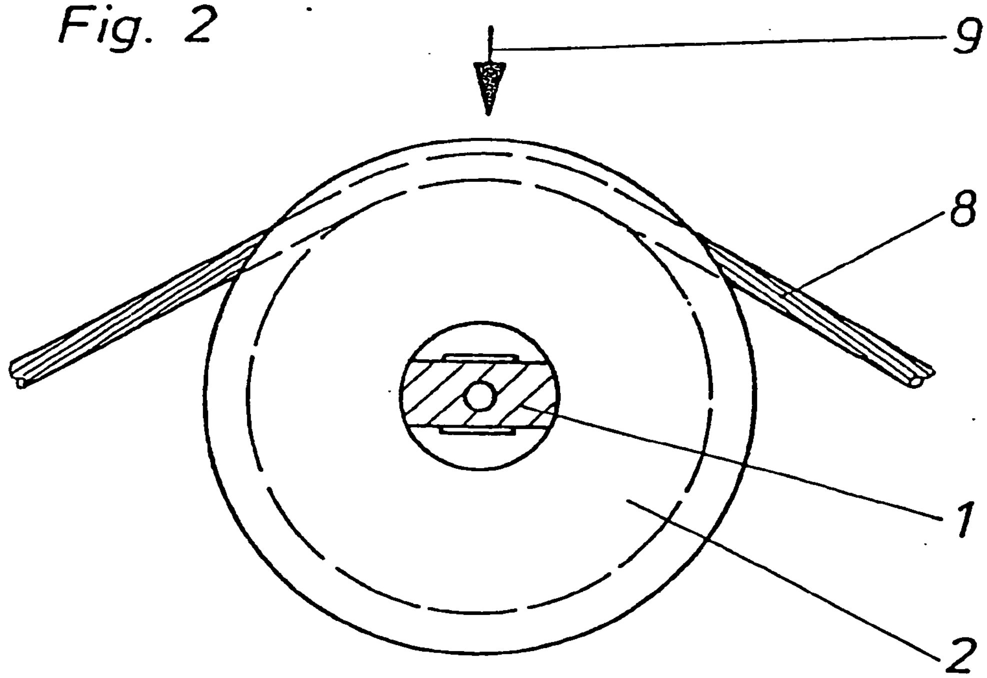


Fig. 3

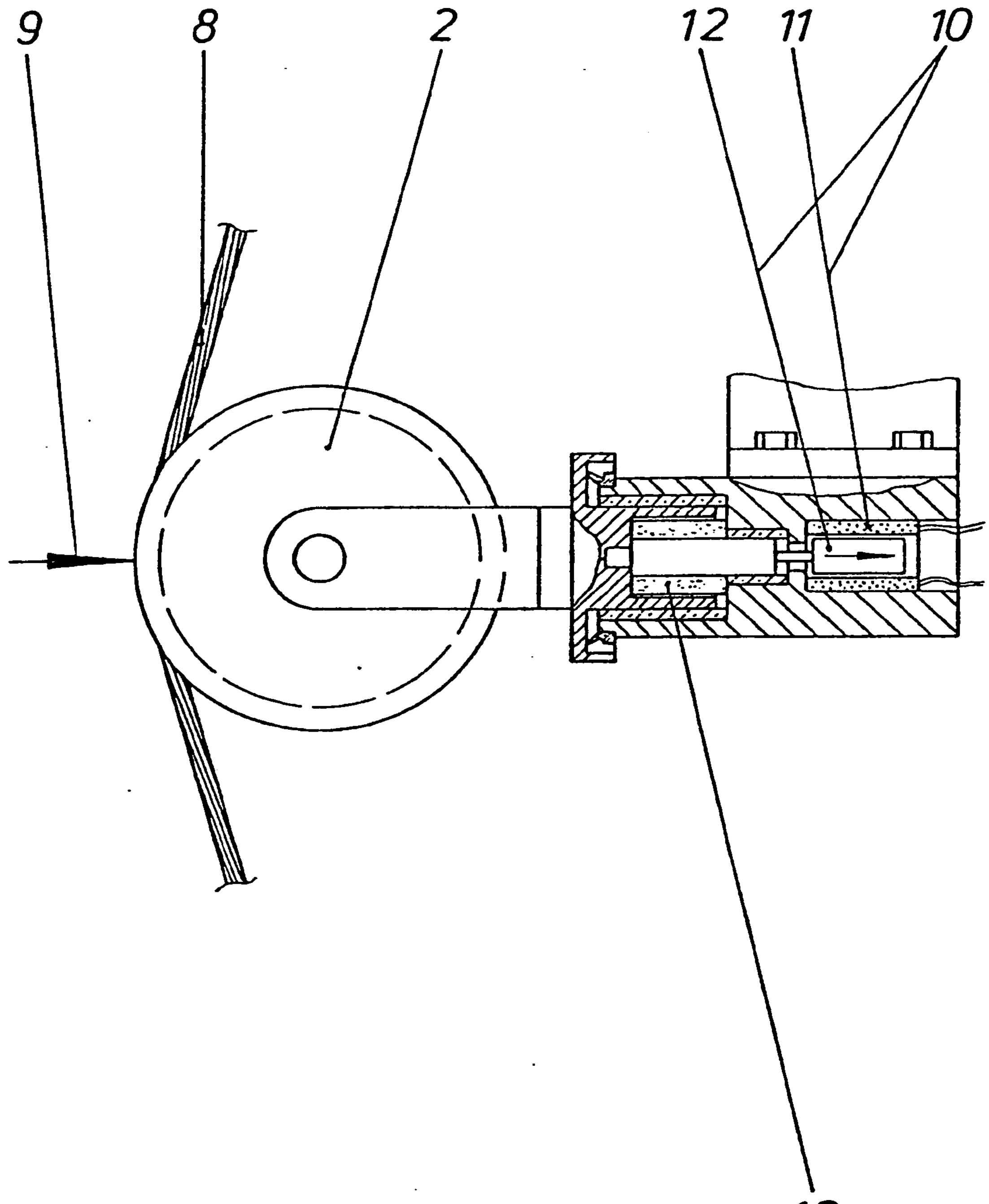


Fig. 4

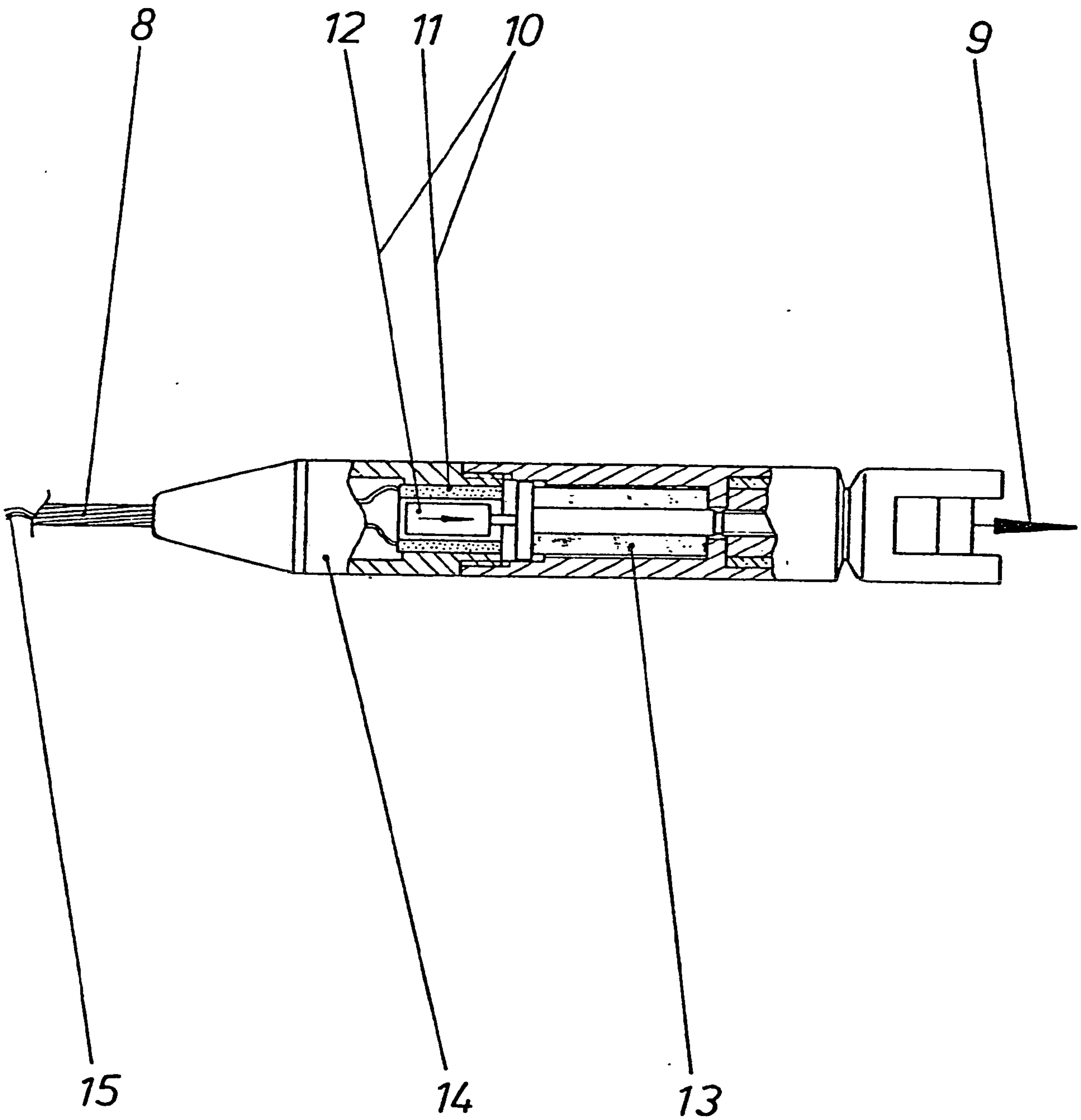
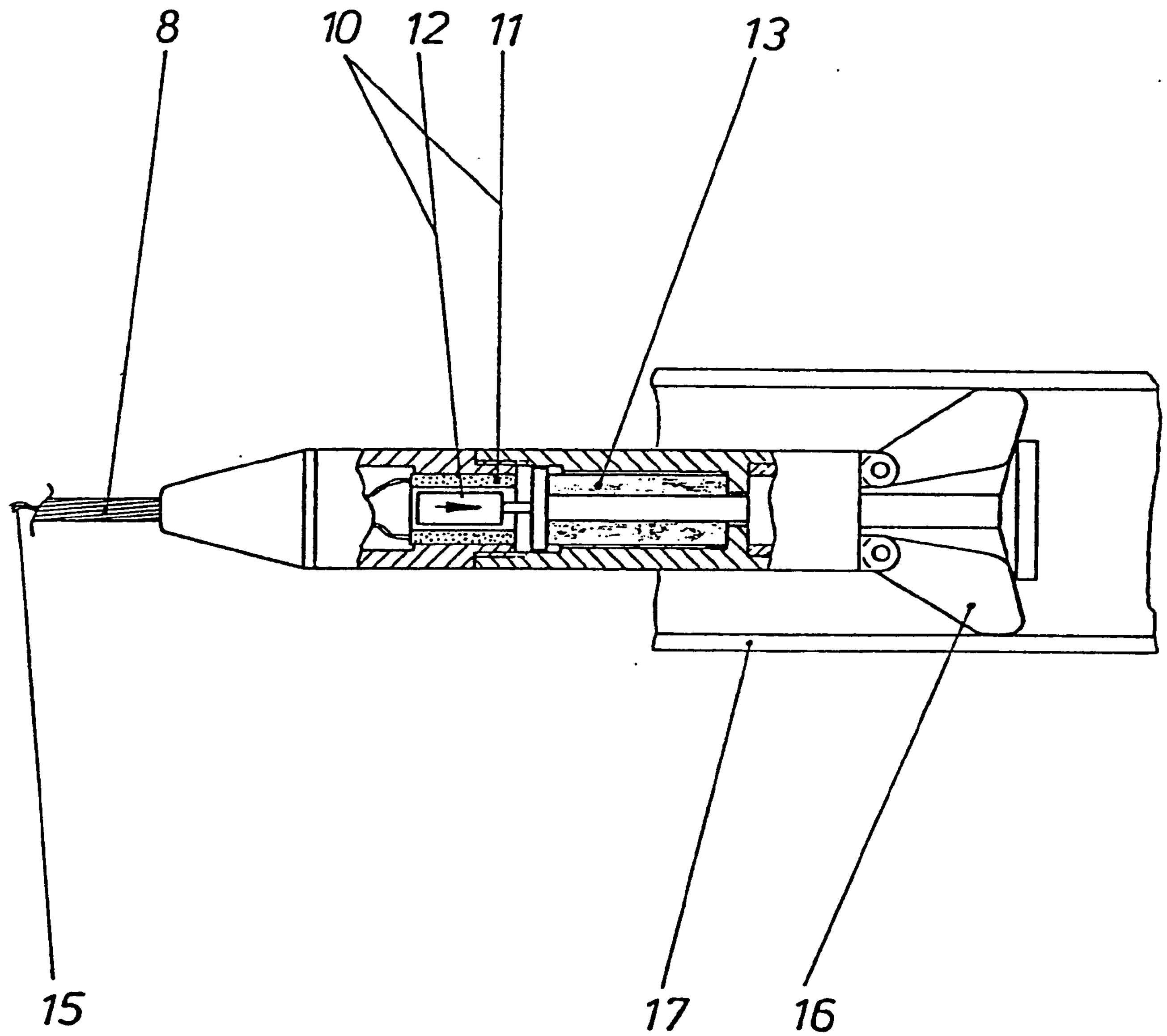


Fig. 5



SPECIFICATION

Measuring and indicating devic s on cabl winches

Motor-driven rope or cable winches, typically mounted on a trailer chassis or on similar vehicles are used for the controlled winding or unwinding of communications, signalling or power cables being laid into cable ducts or trenches. These cable winches are equipped with measuring and indicating devices for determining the tension on the cable and the cable length paid out. High demands are commonly made on the measuring and indicating devices of such cable winches, because it is often necessary to lay cable constructions of a not very robust nature which are also highly sensitive to t nsile stresses. The most recent sensitive cables are, for example, optical fibre communications cables. Apart from these purely technical demands, it is desirable to make the operational control of a cable winch as easy and reliable as possible.

As part of the procedures carried out before pulling cables into cable ducts or conduits, cable winches are also employed, for example, to pull suitable brushes through the ducts in order to cleam them. It is also desirable to pull so-called calibration devices through the ducts in order to determine their free internal diameter.

In known constructions of cable winches, tension measurements in a cable winch are made possible by deflecting a linear cable length guided between two cable pulleys with the aid of a movable, optionally also resiliently mounted, third pulley. The tension in the cable leads to a force component on the movable pulley which is directly proportional to the tensile stress in the cable. The movement of this pulley is supplied, either directly or by means of lever systems, or, for example, by means of lever systems and a hydraulic dynamometer, to an indicating instrument comprising a pointer and a calibrated scale. The tension can thus be read off or, if the indicating instrument is in the form of a curve tracer with a paper tape, it is recorded as a tension curve. The paper tape feed in the curve tracer is effected either by a motor or a spring mechanism, i.e. it is time-dependent, or the paper feed drive is mechanically connected by means of a flexible shaft to a suitable pulley of the cable guide arrangement within the cable winch, thus permitting a length-dependent recording of the tension in the cable to be made.

The recording of a cable winding or unwinding process, as registered by a curve tracer, thus consists of a variable length paper tape on which the tension curve is plotted as a function of the time or length. Necessarily, the curve tracer must be accompanied by a scale ruler, which must contain the sam calibration marks as the curve tracer, in ord r to make it possible to read off the individual tension values after tearing off the paper tape.

The indicating instrument or curve tracer is often provided with contact means which are manually adjustable, so that a limiting tension value specific to each type of cable to be laid can be set. When the instantaneous tension reaches this limiting value, the contact means switch off the drive of the cable winch, thereby avoiding overloading of the cable which is to be laid.

When recording the measured tension and length values in accordance with the present invention, a procedure is adapted to achieve direct conversion of these values into electrically measurable corresponding values. Thus, the principle of producing a force component by deflecting a linear cable section by means of a third cable pulley is retained. However, the third, freely rotating cable pulley is fitted to a fixed shaft, the varying force component bringing about a slight, variable bending of this fixed shaft, which is converted into an electrically measurable value with the aid of one or more strain gauges, which are mounted on a planar surface of the shaft.

An embodiment of a cable winch according to the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows an axial cross section through a cable winch measuring and indicating device in accordance with the invention, having a fixed shaft with measuring sensors;

Figure 2 shows an end view thereof, showing the principle of the effect of the force component acting on the pulley;

Figure 3 shows an axial cross-section of a tension sensor provided with an inductive travel sensor;

Figure 4 shows a cable end bulb for a cable winch in axial cross-section, and

Figure 5 shows an axial cross-section of a cable end bulb for cable winches comprising a calibration device.

In the drawings, a cable pulley 2 is mounted on a fixed shaft 1, and strain gauges 3 are mounted on opposed planar surfaces formed on the shaft 1. The arrow 9, see Figure 2, denotes the force component acting on the fixed shaft 1 due to tension in the cable 8.

A magnetic or optical travel sensor 4 is used for determining the travel or length of the cable 8 moving over the pulley 2, and is located at an appropriate point in the cable winch for example in the same way as the strain gauges 3, on the fixed shaft 1 or on a different pulley of the cable guide train. The sensor 4 is, for example, influenced in a magnetic or optical manner by sheet metal strips 5 or by a perforated partition, which rotate with the cable pulley 2 and can thus be made to supply electrically measurable pulses. The dimensioning of the cable pulley 2 and the number of strips 5 influencing the sensor 4 per rotation of the cable pulley 2 give a number of electrical pulses per rotation and consequently per given length unit, for example one pulse for every ten centimetres of cable.

The analog, electrically measurable values of the wir strain gauges 3 or of th inductive travel sensor 4, can be digitalized, evaluated, calculated and counted in a microprocessor system and can thereby be made known to the operating personnel on electrical indicating or display devices. Indication of the tension in numbers on a display is unfavourable, because these values can change very frequently and rapidly during the unwinding process, so that it

is not r adily possible for the operating personnel to recognise and read them. However, observation of the instantaneous tension during the unwinding of the cable 8 is one of the most important pieces of operating information for personnel controlling the process.

In accordance with a further feature of the invention, the tension of the cable 8 is indicated on a luminous strip, not shown, and is therefore very easily recognisable and evaluatable by the operating personnel. The luminous strip may comprise, for example, 10 lamps or light-emitting diodes, which are juxtaposed in strip-like series. Prior to the unwinding process, a maximum tension value is stored in a microprocessor system, not shown, which is specific to the cable type being laid. This maximum tension value is used to enable the microprocessor to switch off the cable winch if the measured tension reaches or exceeds a stored maximum value during the unwinding process. However, for as long as the stored maximum tension is not exceeded, the microprocessor system calculates the instantaneously measured tension as a percentage of the stored maximum tension and controls its electrical outputs in such a way that the result is shown in the luminous strip in the form of lamps or light-emitting diodes which do or do not light up. If, for example, the tension during the unwinding process reaches 60% of the stored maximum tension, 6 out of 10 or 12 out of 20 lamps or light-emitting diodes in the luminous strip will light up.

Another advantageous piece of working information for operating personnel is the speed of the moving cable, e.g. in metres per minute. For calculating this, the magnetic or optical sensor produces, f r example, one pulse for every 10 centimetres of moving cable, i.e. the given length unit of the speed value. The microprocessor system is able to produce a timing or time base, i.e. a given time unit, and thus calculate from the two items of data a constantly refreshed cable speed, which is shown on a display.

The microprocessor system permits the connection of a paper tape printer, the feeding in of specific texts, as well as the storage of intermediate and maximum values for the tension, length and speed. It is possible to produce or print out a working record which, apart from the graphic representation of the tension curve and length, shows in the manner of a form and document all stages of the cable unwinding process.

In accordance with a still further feature of the invention, the shaft 1, strain gauges 3 and travel sensor 4 are enclosed by a flanged cylinder 6 which bears against the pulley 2 through a seal 7 such as a lip seal.

As her inbefore d scribed, the actual data f cable speed and tension are available in the microproc ssor system of the cable winch. Both sets f data are displayed. It is the task of the cable winch operator to control the speed of the cable winch and thus of the laying procedure by hand in such a way that as high as possible a speed is achieved without exceeding the tension limit. Regulation of the cable speed is effected by means of a lever which controls the oil flow in the hydraulic drive of the cable winch. In the case of an electric drive of the cable winch the lever would have a corresponding electric function for regulating the speed of the cable.

This invention includes electronic control of the control lever, for example by means of a servo motor, which is effected by the microprocessor systems. When the tension is, for example, 25% of the tension limit, the cable speed can be increased by automatic control. When the tension, however, rises to 95%, for example, of the tension limit, the microprocessor system can be so programmed that the cable speed is reduced.

Referring to Figure 3, a further possibility of the direct conversion of the tension is the use of an inductive travel sensor 10, consisting of a coil 11 with a central tap and a movable mumetal core 12. Changes in position of the mumetal core 12 effect measurable changes of the electrical characteristics of the coil 11 if supplied with an alternating voltage. According to the invention the movement of the mumetal core 12 is effected by a resilient mounting 13 for a third cable pulley 2 over which the cable 8 runs and on which the cable applies a component force proportional to the cable tension as shown by the arrow 9.

Tension measurement device, which are disposed on the cable winch itself, record the total tension which is applied to the cable during laying thereof, and which is composed on the following factors:

A Weight (mass) of the winch cable;

B Friction of the winch cable in the cable duct or trench;

C Weight (mass) of communication cable attached to the winch cable;

D Friction of the communication cable in the duct or trench;

E Force necessary for pulling the communication cable off a storage drum.

In the latest developments of cable winch design the devices for measuring cable tension or additional, second measurement devices are disposed at the free initial portion of the cable, so that only the above-mentioned tensile forces C, D and E are recorded. The tensile forces C, D and E are those forces acting on the cable to be laid, for which in each case a specific maximum tension is indicated by the manufactures. Devices disposed at the initial portion of the cable for measuring tension do not deal with the above-mentioned tensions A and B. This disposition is particularly important when the cable winches are to be used for laying light cables which are sensitive to tensile stress, for example fibre optic cables, in which case the tensile forces A and B constitute a relatively large portion of the total tension. This is so, for example, because the weight and friction of the winch cable (A and B) ar greater than those of the communication cable (C, D and E).

R ferring to Figure 4, this invention is concerned also with the construction of the cable terminati n at the free initial portion of the cable, including the devices situated there for the measurement of tensile stresses. This cable termination is referred to as a cable nd bulb 14 with tension measuring device. It consists of two groups of parts, which are

resiliently mechanically conn cted at 13. The first group of parts is firmly connected with th winch cable 8 of the cable winch and the coil 11 of an inductive travel sensor is integrated in it.

The connecting wires of the coil 11 are connected inside the group of parts described here with electrically insulated conductors 14, which have to be present in the winch cable 8 and which transmit the electrically measurable values of the inductive travel sensor 10 to the electronic apparatus in the cable winch.

The second group of parts of the cable end bulb 14 consist of the mechanical parts for securing, for example, a cable pulling envelope or a cable pulling head, and the mumetal core 12 of an inductive travel sensor 10 is provided on it. When the two groups of parts are resiliently joined in suitable manner at 13, the mumetal core 12 moves in the coil 11 proportionately to the tension 9 to which the cable end bulb 14 is subjected during laying of a communications cable.

Referring to Figure 5, the second group of parts shown in Figure 4 may also be adapted as a calibration device for measuring the free internal diameter of cable ducts 17. In this case also the quantity to be measured is largely converted into values which can be measured electrically. The second group of parts is in that case provided with several mechanical sensing elements 16, which resile against the inner wall of the cable duct 17. When this calibration device is pulled through the cable duct 17, the sensors 16, which are resiliently mounted, are moved according to the internal diameter of the duct 17. This movement, mechanically transferred to the mumetal core 12, causes changes in the electrical characteristics of the coil 11 of the inductive travel sensor 10 dependent upon the diameter and hence gives rise to electrically measurable values, which can be processed in the microprocessor system of the cable winch and can be displayed analogous to the tensile stresses.

CLAIMS

1. A cable winch equipped with measuring devices for the cable length and tension, wherein the tension is measured at a fixed shaft supporting a rotary cable pulley and strain gauges convert the tension-dependent bending of the shaft into an lectrically measurable value, the wire strain gauges being positioned on a planar surface formed on the shaft.

2. A cable winch according to claim 1, wherein the cable length is determined by a magnetic or optical sensor by fitting magnetically acting or optically acting steel metal strips or perforated partitions to one of the rotary cable pulley and the shaft, the sensor being carried by the other of said pulley and shaft.

3. A cable winch according to claim 2, wh rein both th strain gauges and th magnetic or ptical s nsor are fitted t th fixed shaft and these compon nts are protected against environm ntal influences by a fixed, flanged cylinder, as well as a seal, e.g. a lip seal, which bears on the rotating cable pulley.

4. A cable winch for laying cables, comprises tension measuring devices, wher in an inductive travel sensor is used for the conversion of the tension into electrically measurable quantities, the mumetal core of which is moved by a resiliently mounted cable pulley on which the traction cable applies a force proportional to the traction force.

5. A cable winch for laying cables comprising tension measuring devices according to Claim 4, wherein the inductive travel sensor is disposed in the cable end bulb and comprises two resiliently connected groups of parts, and the resilient effect of which is used for the proportional movement of the mumetal core of the inductive travel sensor.

6. A cable winch for laying cables according to Claims 4 or 5, wherein the traction cable is provided with a suitable number of insulated conductors for the transmission of the electric values of the inductive travel sensor.

7. A cable winch for laying cables according to Claim 5, wherein a group of parts of the cable end bulb, which consists of two resiliently connected groups of parts, is provided with resiliently mounted mechanical feeler elements which can, while feeling the inner wall of a duct, scan the internal diameter of the duct, and wherein changes of the internal diameter of the duct are converted into a movement of the mumetal core of the inductive travel sensor and consequently into electrically measurable values.

8. A cable winch, equipped with a microprocessor system which processes the electrically measurable values of the strain gauges according to Claim 1 or any Claim appendant thereto, or Claims 4 or 5, and to which are connected peripheral indicating and/or display devices, such as printers, displays and luminous elements, wherein the tension is indicated on a luminous strip, comprising a plurality of lamps or light-emitting diodes, or a so-called roll display, in such a way that the proportion of the luminous strip which lights up or is marked represents the percentage of the instantaneous tension as compared with a set maximum tension.

9. A cable winch according to Claim 8 when appendant to Claim 2, characterised in that length-specific, electrical pulses produced by the magnetic or optical sensor and a time unit produced by the microprocessor system are jointly used for calculating the speed of the cable movement and for displaying it on a display.

10. A cable winch according to Claim 8 or Claim 9, wherein the printer sets on paper a graphical representation of the cable length and tension, as well as a form-like text and the limit data for the tension, cable length and speed, for documenting the complete cable winding or unwinding process.

11. A cable winch according to Claim 8 or Claim 9, wherein the cable speed computed by the microprocessor system as well as the actual tension at any time are used for th electronic control of a maximum cabl speed below the selectable tension limit.

12. A cable winch t nsion and/or length measuring device substantially as hereinbefore described with reference to the accompanying drawings.

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